BACnet / Modbus Client

Intesis ST Cloud

USER MANUAL

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Important User Information

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Gateway for the integration of BACnet devices (IP or MS/TP) or Modbus devices (TCP and RTU) into Intesis ST Cloud Control solution.

ORDER CODES	LEGACY ORDER CODES
INSTCMBG0040000	-
INSTCMBG0080000	-
INSTCMBG0160000	-
INSTCMBG0320000	-

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1 Description

1.1 *Introduction*

This document describes the integration of BACnet MSTP, BACnet IP, Modbus TCP and Modbus RTU devices into Intesis ST (Standard) Cloud Control solution using the Intesis *Standard Cloud – BACnet/Modbus* gateway.

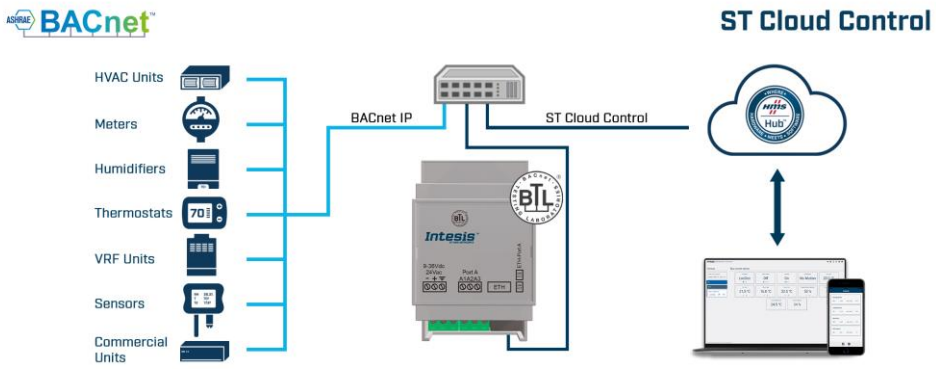
The aim of this integration is to make accessible BACnet or Modbus system signals and resources from a cloud-based platform as if it was a part of the own BACnet/Modbus system and vice-versa.

From BACnet point of view, Intesis acts as a BACnet client device, able to subscribe (COV) or do periodic polling of configured BACnet points. From a Modbus point of view, Intesis acts as a Modbus client device polling signals from the corresponding Modbus server devices and writing on them when requested.

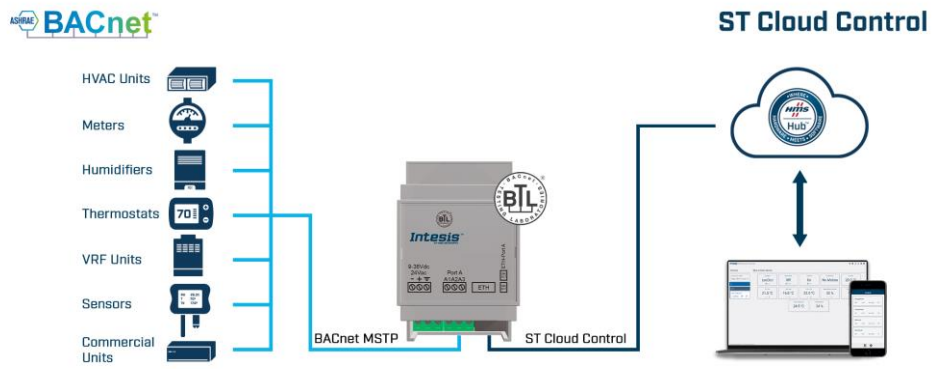
Configuration is carried out using the configuration software Intesis™ MAPS.

This document assumes that the user is familiar with BACnet, Modbus and Cloud-based technologies and their technical terms.

Integration of BACnet IP devices into ST Cloud Control



Integration of BACnet MS/TP devices into ST Cloud Control



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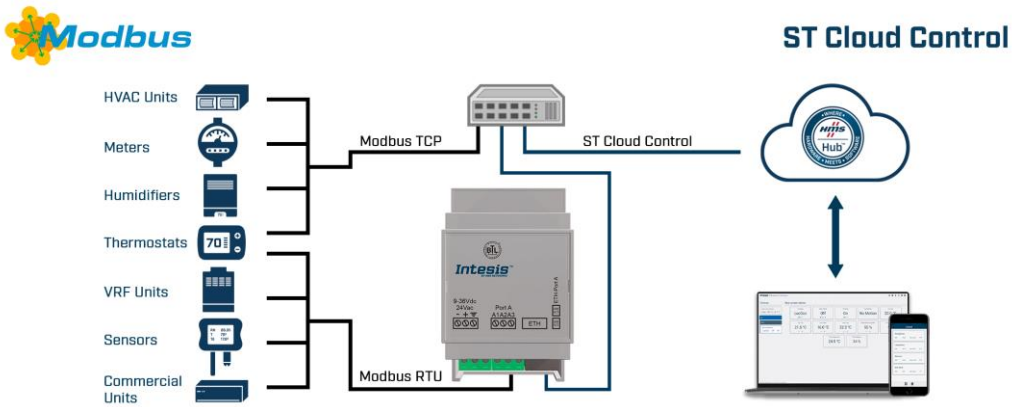
Integration of Modbus TCP and Modbus RTU devices into ST Cloud Control



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1.2 *Functionality*

After the start up process, Intesis helps route BACnet/Modbus communications from BACnet or Modbus devices to the cloud.

In the case of BACnet integration, each BACnet object from the BACnet server devices is associated to a data point in the cloud. When a new value is read from BACnet for a given object/present_value, the new value is updated in the gateway's memory and made accessible at the cloud side.

In the case of Modbus intergration, each Modbus register from the Modbus server devices is associated to a data point in the cloud. When a new value is read from Modbus for a given register, the new value is updated in the gateway's memory and made accessible at the cloud side.

Notice that the gateway will move data from BACnet or Modbus to the cloud and viceversa in a transparent away and according to the configuration project created through MAPS.

1.3 *Gateway's capacity*

Intesis capacity is listed below:

Element	4 version	8 version	16 version	32 version	Notes
BACnet layers supported	BACnet IP BACnet MS/TP (EIA485)				Communication with BACnet IP and MS/TP
Modbus layers supported	Modbus TCP Modbus RTU (EIA485)				Communication with Modbus TCP and RTU
Number of BACnet Slave/Server devices	4	8	16	32	Max number of BACnet devices supported
Number of Modbus Slave/Server devices*	4	8	16	32	Max number of Modbus devices supported
Virtual Devices in the cloud	4	8	16	32	Max number of virtual devices in the cloud
Widgets in the cloud	48	96	192	384	Max number of widgets per project

*Note: Up 5 Modbus TCP nodes on a single gateway

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2 ST Cloud Control interface

From the ST Cloud Control, the gateway works as a routing tool to receive data from the cloud and to send the data to the cloud too. Connection is directly with the HMS HUB.

Data structure in the cloud is as follows:

- **Virtual Device:** Is a device created in the cloud and is composed by one or more widgets.
- **Widget:** Is a minimum visualization unit used to show information and is composed by on or more items.
- **Item:** Is the correspondence with the present value of a BACnet Object or a Modbus register value.

Please check section 1.3 for more information about the maximum number of elements depending on the license version you may have.

2.1 *Points definition*

Every point defined in the ST Cloud side is related to a single item, so it might be part of a widget, which at the same time is part of a Virtual Device.

Feature	Description
Device	**Identifies to which device the item refers to.**
Widget	**Identifies to which widget the item refers to.**
R/W	**Indicates if the item is:** • Read • Write • Read/Write • Read and Write
Bit	**Indicates the bit the item refers to.** This only applies for Binary widgets.

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3 BACnet interface

This section describes the BACnet part of the Intesis' configuration and functionality.

3.1 *Description*

BACnet server devices are represented in the form of *Devices* holding *Objects*, normally every physical device corresponds to a logical one. The *Objects* can be of different type depending on the data and functionality the represent: Analog Input, Analog output, Digital Input, etc. Up to 23 different types of objects. Note that Outputs are objects meant to be written in the direction BACnet network to the device, and the opposite for Inputs (they are meant to offer status information of the BACnet device). Value objects are bidirectional.

Every *Object* has different properties. The most meaningful one, and the one used to read and write values by Intesis is the *Present Value* property, which indicates the real value of the object. Every Object of the same type in a *Device* is identified with its associated *Object Instance*.

These are the possible BACnet objects supported by Intesis:

Object Type	Property	Description
Analog Input	Present Value	Analog signal. i.e. Ambient temperature.
Analog Output	Present Value	Analog signal.
Analog Value	Present Value	Analog signal. i.e. Temperature set point value.
Binary Input	Present Value	Digital signal. i.e. ON/OFF status.
Binary Output	Present Value	Digital signal. i.e. ON/OFF command.
Binary Value	Present Value	Digital signal. i.e. ON/OFF status/command.
Multistate Input	Present Value	Multistate signal. i.e. Working mode status.
Multistate Output	Present Value	Multistate signal.
Multistate Value	Present Value	Multistate signal. i.e. Working mode command.
Accumulator	Present Value	
Loop	Present Value	

Every signal is identified with its associated *Device* + *Object Type* + *Object Instance*.

Intesis simulates a virtual BACnet device inside the BACnet system acting as client device in the BACnet system. The communication with the rest of the BACnet devices is done via the Ethernet port of the gateway which implements the BACnet protocol.

Intesis implements a single BACnet object of its own: this is, its BACnet Device Object, containing its BACnet Device Identifier and basic properties of Intesis as BACnet device (name, firmware version, etc).

Using the configuration tool with Intesis it's possible to scan the BACnet network for available devices and their objects, which can later be directly added to your configuration. This facilitates the configuration process, avoiding to enter them manually.

BACnet/IP and BACnet MSTP physical layers are supported. Only one physical layer can be used at a time. This is, if communicating to BACnet using BACnet/IP, BACnet MSTP cannot be used, and viceversa.

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3.2 *BACnet/IP*

Main parameter to set up for BACnet/IP, additional to basic IP settings (IP, netmask, default gateway) is the communication port. Intesis uses port 47808 (0xBAC0) by default and it can be changed at configuration time.

When using BACnet/IP, device can also act as a Foreign Device (in order to be able to communicate with devices that are in another network domain), alternatively implement a BBMD itself (Bacnet/IP Broadcast Management Device). This functionality facilitates communication of devices in other networks with the devices in the network where Intesis is installed.

Communication with BACnet/IP excludes possibility of communicating with BACnet MSTP from Intesis.

3.3 *BACnet MSTP*

When choosing BACnet MSTP device needs to be associated with a MAC address (address within the MSTP network segment), to be configured with configuration software.

Following baud rates are supported for MSTP line: 9600, 19200, 38400, 76800, 115200 or Autobauding (autodetect).

Standard wiring guidelines for EIA485 apply for the BACnet MSTP line.

Communication with BACnet MSTP excludes possibility of communicating with BACnet/IP from Intesis.

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3.4 *Points definition*

Every point defined in Intesis has the following BACnet features associated to it:

Feature	Description
BACnet Device	BACnet device to which belongs the point, from a list of BACnet devices that can be defined in Intesis (up to 16). For every BACnet device defined, a virtual signal is created automatically in Intesis to inform about the communication with the BACnet device, this signal is available also from the Modbus interface like the rest of points.
BACnet object type	BACnet object type for the point. It can be one of the following BACnet object types supported by Intesis: AI = Analog Input. AO = Analog Output. AV = Analog Value. DI = Digital Input. DO = Digital Output. DV = Digital Value. MI = Multistate Input. MO = Multistate Output. MV = Multistate Value. LOOP = Loop ACUM = Accumulator *Consult documentation of BACnet device(s) to integrate for information about BACnet object types of the points desired to integrate.*
BACnet object instance	BACnet object instance for the point on the external BACnet device. *Consult documentation of BACnet device(s) to integrate for information about BACnet object instance of the points desired to integrate.*

Note that configuration tool used with Intesis enables for discovery of existing BACnet devices in the network, as well as their BACnet objects and types, which can be later directly added in configuration. This facilitates the process of choosing suitable parameters above for every BACnet object on every BACnet device to integrate

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4 Modbus interface

4.1 *Description*

Intesis acts as a master device in its Modbus interface. This interface can be the Ethernet port (if using Modbus TCP), or the EIA232/EIA485 port (if using Modbus RTU). To access the points and resources of the slave Modbus device, you must specify the corresponding Modbus register addresses. These registers and functions can be configured inside Intesis gateway using MAPS. See details below in this document.

The Intesis can have Modbus RTU mode active, Modbus TCP mode active, or both modes active at the same time.

4.2 *Functions supported*

This part is common for Modbus TCP & RTU.

Modbus functions 01 and 02 (*coils and digital input registers*) can be used to read Modbus registers.

Modbus functions 03 and 04 (*read holding registers* and *read input registers*) can be used to read Modbus registers.

Modbus functions 05 and 15 (*Single digital Holding Registers* and *Write Multiple Holding Registers*) can be used to write Modbus registers.

Modbus functions 06 and 16 (*Single Multiple Holding Registers* and *Write Multiple Holding Registers*) can be used to write Modbus registers.

If *poll records* are used to read or write more than one register, it is necessary that the range of addresses requested contains valid addresses; if not the corresponding Modbus error code will be returned.

All the registers are of 2 bytes, even if they are associated to signals of type bit in the external system, and its content is expressed in MSB..LSB.

Modbus error codes are fully supported; they will be sent whenever a non-valid Modbus action or address is required.

4.3 *Modbus RTU*

Baud rate can be selected from 1200, 2400, 4800, 9600, 19200, 38400, 56700 and 115200.
Data Bits:8
Parity can be selected from: none, even, odd.
Stop Bits:1 and 2.

Modbus slave number can be configured. Physical connection (EIA232 or EIA485) can also be selected.

Only the lines RX, TX and GND of the EIA232 connector are used (TX/RX+ and TX/RX- for EIA485).

4.4 *Modbus TCP*

The TCP port to use can be configured (by default 502 is used).

The IP address, subnet mask and default router address to use by Intesis can be also configured.

4.5 *Address Map*

The Modbus address map is fully configurable; any point in the Intesis can be freely configured with the desired Modbus register address.

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4.6 *Points definition*

Every point defined in the gateway has the Modbus *Format, Point and R/W* features associated to it that can be configured. These features are explained in section 6.2.4.

Each point defined in Intesis has the following Modbus features associated to it:

Feature	Description
#Bits	**One of the following bit lengths can be used:** • 1 bit • 16 bits • 32 bits
Data Coding Format	**One of the following Modbus data coding formats can be used:** • 16/32 unsigned. • 16/32 bits signed (one's complement – C1). • 16/32 bits signed (two's complement – C2). • 16/32 bits Float. • 16/ bits Bitfields. • Error comm
Function code	**One of the following Modbus function codes can be used:** • 1- Read Coils. • 2- Read Discrete Inputs. • 3- Read Holding Registers. • 4- Read Input Registers. • 5- Write Single Coil. • 6- Write Single Register. • 15- Write Multiple Coils. • 16- Write Multiple Registers.
Byte Order	• Big Endian • Little Endian • Word Inverted Big Endian • Word Inverted Little Endian
Register Address	The Modbus register address inside the slave device for the point.
Bit inside the register	Bit inside the Modbus register (optional). The gateway allows bit decoding from generic 16 bits input/holding Modbus registers. *Bit coding into 16 bits input/holding Modbus registers is used for some devices to encode digital values into this type of registers, being these registers normally accessible using Modbus function codes 3 and 4 (read holding/input registers).*
Read/Write	0: Read 1: Write 2: Read / Write

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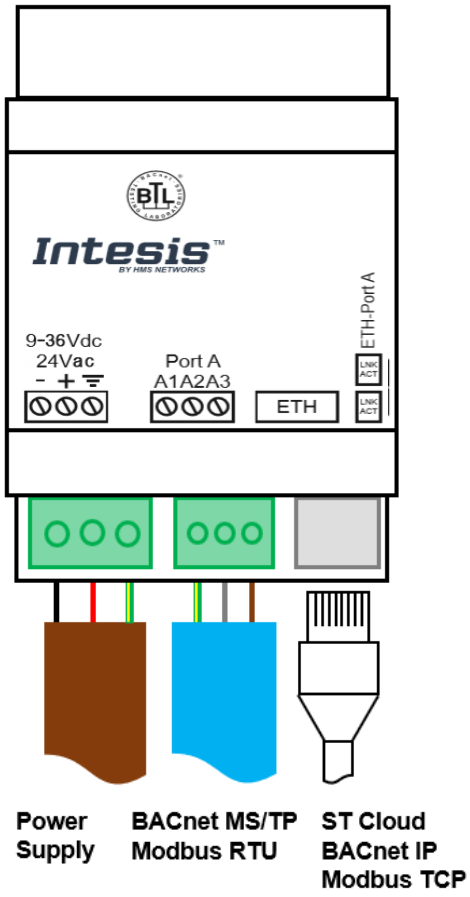
5 Connections

Find below information regarding the Intesis connections available.



Power Supply
Must use NEC Class 2 or Limited Power Source (LPS) and SELV rated power supply. Respect polarity applied of terminals (+) and (-). Be sure the voltage applied is within the range admitted (check table below). The power supply can be connected to earth but only through the negative terminal, never through the positive terminal.

Ethernet (ST Cloud, BACnet IP, Modbus TCP and console)
Connect the cable coming from the IP network to the connector ETH of the gateway. Use an Ethernet CAT5 cable. If communicating through the LAN of the building, contact the network administrator and make sure traffic on the port used is allowed through all the LAN path (check the gateway user manual for more information). With factory settings, after powering up the gateway, DHCP will be enabled for 30 seconds. After that time, if no IP is provided by a DHCP server, the default IP 192.168.100.246 will be set.

Port A (BACnet MS/TP or Modbus RTU)
Connect the EIA485 bus to connectors A3 (A), A2 (B) and A1 (SNGD) of gateway's Port. Respect the polarity.

Note for MS/TP port: *Remember the characteristics of the standard EIA485 bus: maximum distance of 1200 meters, maximum 32 devices connected to the bus, and in each end of the bus it must be a termination resistor of 120 Ω.*

Ensure proper space for all connectors when mounted (see section 8).

5.1 *Powering the device*

A power supply working with any of the voltage range allowed is needed (check section 7). Once connected the RUN led (Figure above) will turn on.

WARNING! In order to avoid earth loops that can damage the gateway and/or any other equipment connected to it, we strongly recommend:

- The use of DC power supplies, floating or with the negative terminal connected to earth. **Never use a DC power supply with the positive terminal connected to earth**.

5.2 *Connection to ST Cloud*

Connect the communication cable coming from the network hub or switch to the ETH port (Figure above) of Intesis. The cable to be used shall be a straight Ethernet UTP/FTP CAT5 cable. Notice that this connection will be used for the Modbus TCP or BACnet IP communication, so only one Ethernet cable needs to be connected to the gateway directly.

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5.3 *Connection to BACnet*

5.3.1 BACnet IP

Connect the communication cable coming from the network hub or switch to the ETH port (Figure above) of Intesis. The cable to be used shall be a straight Ethernet UTP/FTP CAT5 cable. Notice that this connection will be used for the Modbus TCP and the ST Cloud communication, so only one Ethernet cable needs to be connected to the gateway directly.

In case there is no response from the BACnet devices to the frames sent by Intesis, check that they are operative and reachable from the network connection used by Intesis. Check the Intesis Ethernet interface sending *Pings* to its IP address using a PC connected to the same Ethernet network.

Check as well with the network admin that there are no limitations regarding UDP communication or ports blocked.

5.3.2 BACnet MSTP

Connect the EIA485 bus to connectors A (B+), B (A-) and SG (SNGD) of gateway's Port. Respect the polarity.

Remember the characteristics of the standard EIA485 bus: maximum distance of 1200 meters, maximum 32 devices connected to the bus, and in each end of the bus it must be a termination resistor of 120 Ω.

5.4 *Connection to Modbus*

5.4.1 Modbus TCP

Connect the communication cable coming from the network hub or switch to the ETH port of Intesis. The cable to be used shall be a straight Ethernet UTP/FTP CAT5 cable. Notice that this connection will be used for the BACnet IP and the ST Cloud communication, so only one Ethernet cable needs to be connected to the gateway directly.

5.4.2 Modbus RTU

Connect the communication cable coming from the Modbus network to the port marked as Modbus of Intesis. Connect the EIA485 bus to connectors A3 (A-), A4 (B+) and A1 or A2 (SNGD) of gateway's PortA. Respect the polarity.

Remember the characteristics of the standard EIA485 bus: maximum distance of 1200 meters, maximum 32 devices connected to the bus, and in each end of the bus it must be a termination resistor of 120 Ω. The gateway has an internal bus biasing circuit that incorporates the termination resistor. If you install the gateway in one of the ends of the bus, then do not install an additional termination resistor in that end.

5.5 *Connection to the configuration tool*

This action allows the user to have access to configuration and monitoring of the device (more information can be found in the configuration tool User Manual). Use the Ethernet port to connect to the configuration tool.

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6 Set-up process and troubleshooting

6.1 *Pre-requisites*

In case of BACnet integration, it is necessary to have a BACnet IP client or MSTP device operative and well connected to the corresponding BACnet port of Intesis.

In case of Modbus integration, it is necessary to have a Modbus TCP client or RTU slave operative and well connected to the corresponding Modbus port of the Intesis gateway.

Connectors, connection cables, PC to use the configuration tool and other auxiliary material, if needed, are not supplied by HMS Industrial Networks S.L.U for this standard integration.

Items supplied by HMS Networks for this integration are:

- Intesis gateway.
- Link to download the configuration tool.
- Product documentation.

IMPORTANT: In case you want to check the complete integration with the cloud, remember that you will need to have an account created as well as the device registered and added to this account. Please, refer to the user manual for the ST Cloud Control solution for more information about that.

6.2 *Intesis MAPS. Configuration & monitoring tool for Cloud Solutions*

6.2.1 Introduction

Intesis MAPS is a Windows® compatible software developed specifically to monitor and configure Intesis Cloud Solutions series.

The installation procedure and main functions are explained in the *Intesis MAPS User Manual*. This document can be downloaded from the link indicated in the installation sheet supplied with the Intesis device or in the product website at www.intesis.com

In this section, only the specific case of the ST Cloud Control will be covered.

Please check the Intesis MAPS user manual for specific information about the different parameters and how to configure them.

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6.2.2 Connection

To configure the Intesis connection parameters press on the ***Connection*** button in the *menu bar*.

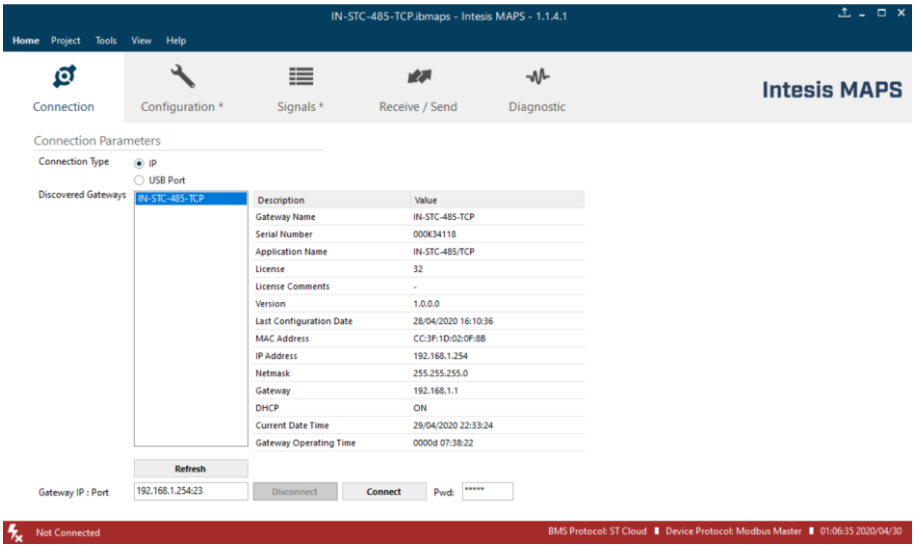

Figure 6.1 MAPS connection

6.2.3 Configuration tab

Select the ***Configuration*** tab to configure the connection parameters. Two subsets of information are shown in this window: General (Gateway general parameters) and BACnet Router (BACnet interface configuration).

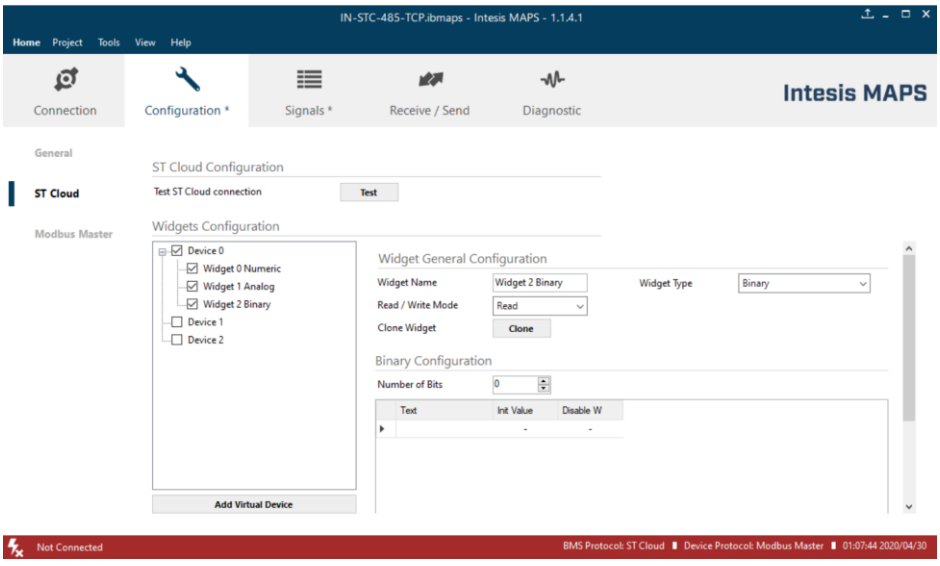

Figure 6.2 Intesis MAPS configuration tab

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6.2.4 Signals

All available objects, Object Instances, are listed in the signals tab. More information on each parameter and how to configure it can be found in the Intesis MAPS user manual.

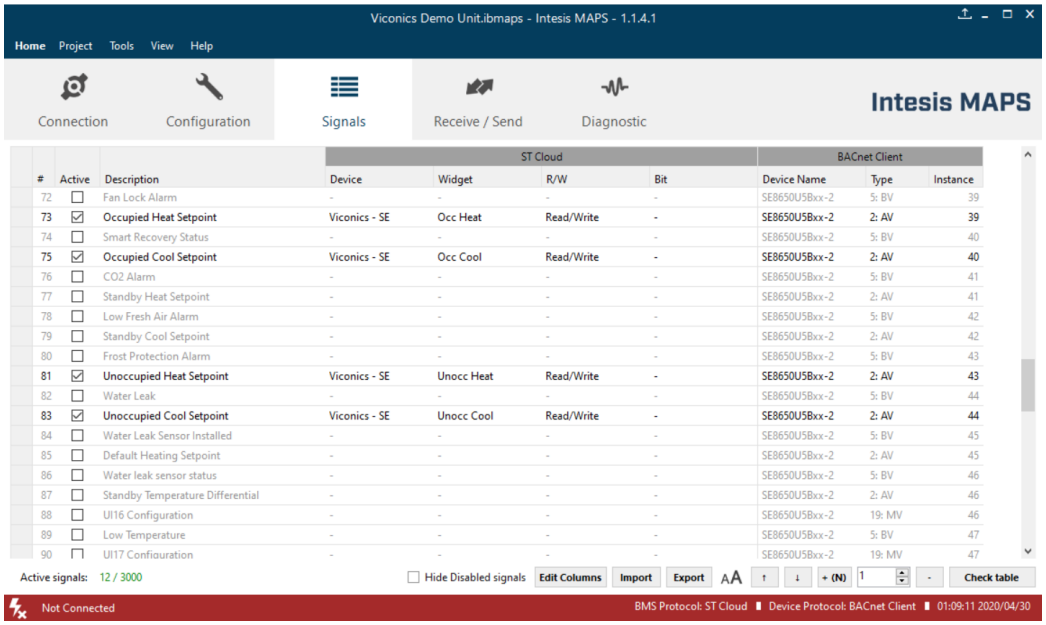

Figure 6.3 Intesis MAPS Signals tab

6.2.5 Sending the configuration to Intesis

When the configuration is finished, follow the next steps.

1.- Click on ***Save*** button to save the project to the project folder on your hard disk (more information in Intesis MAPS User Manual).

2.- You will be prompted to generate the configuration file to be sent to the gateway.

a.- If ***Yes*** is selected, the file containing the configuration for the gateway will be generated and saved also into the project folder.

b.- If ***NO*** is selected, remember that the binary file with the project needs to be generated before the Intesis starts to work as expected.

3.- Press the ***Send File*** button to send the binary file to the Intesis device. The process of file transmission can be monitored in the Intesis Communication Console window. Intesis will reboot automatically once the new configuration is loaded.

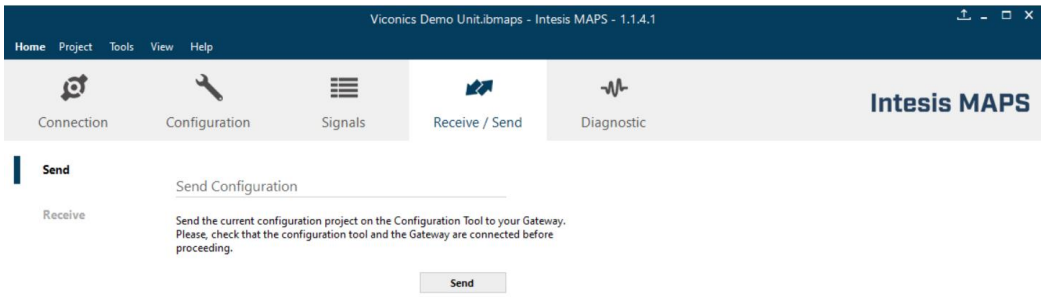

Figure 6.4 Intesis MAPS Receive/Send tab

After any configuration change, do not forget to send the configuration file to the Intesis using button Send File.

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6.2.6 Diagnostic

To help integrators in the commissioning tasks and troubleshooting, the Configuration Tool offers some specific tools and viewers.

In order to start using the diagnostic tools, connection with the Gateway is required.

The Diagnostic section is composed by two main parts: Tools and Viewers.

- **Tools**
  Use the tools section to check the current hardware status of the box, log communications into compressed files to be sent to the support, change the Diagnostic panels' view or send commands to the gateway.

- **Viewers**
  In order to check the current status, viewer for the Internal and External protocols are available. It is also available a generic Console viewer for general information about communications and the gateway status and finally a Signals Viewer to simulate the BMS behavior or to check the current values in the system.

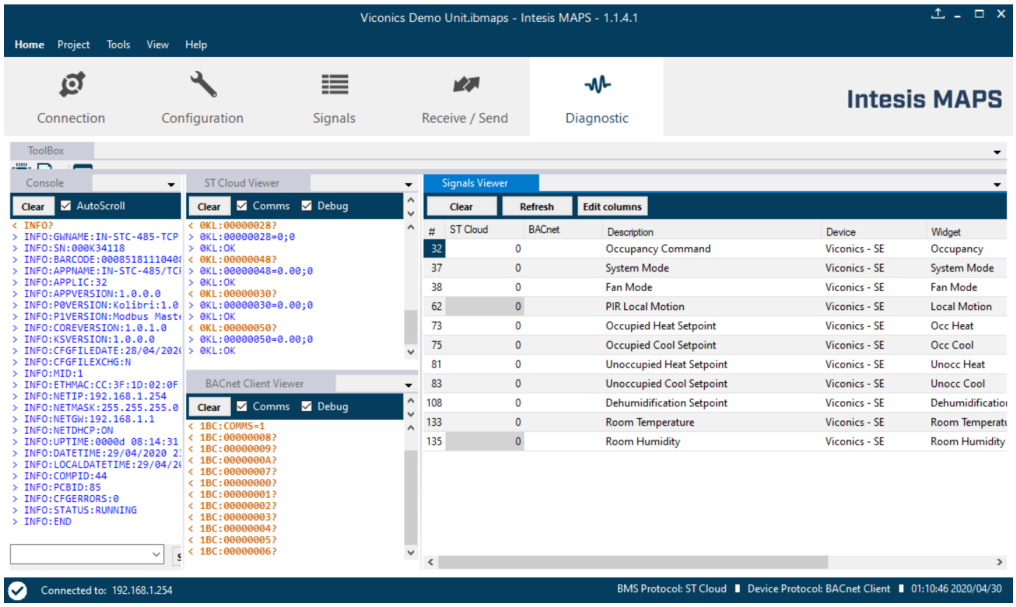

Figure 6.5 Diagnostic

More information about the Diagnostic section can be found in the Configuraion Tool manual.

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6.3 *Set-up procedure*

1. Install Intesis MAPS on your laptop, use the setup program supplied for this and follow the instructions given by the Installation wizard.

2. Install Intesis in the desired installation site. Installation can be on DIN rail or on a stable not vibrating surface (DIN rail mounted inside a metallic industrial cabinet connected to ground is recommended).

3. Connect the Ethernet cable for Cloud communication and for BACnet IP or Modbus TCP communication (More details in section 0).

   If using BACnet MSTP or Modbus TCP, connect the communication cables coming from the BACnet MSTP or Modbus RTU network to the port marked as Port A on Intesis (More details in section 0).

4. Power up Intesis. The supply voltage can be 9 to 24 Vdc. Take care of the polarity of the supply voltage applied.

   WARNING! In order to avoid earth loops that can damage Intesis and/or any other equipment connected to it, we strongly recommend the use of DC power supplies, floating or with the negative terminal connected to earth. **Never use a DC power supply with the positive terminal connected to earth**.

5. If you want to connect using IP, connect the Ethernet cable from the laptop PC to the port marked as ETH of Intesis (More details in section 0).

6. Open Intesis MAPS, create a new project selecting the Modbus template (IBOX-STC-MBM template) or BACnet template (IBOX-STC-BAC template) according to your project needs.

7. Modify the configuration as desired, save it and download the configuration file to Intesis as explained in the Intesis MAPS user manual.

8. Visit the Diagnostic section and check that there is communication activity, some TX frames and some other RX frames. In case there is no communication activity between Intesis and the BACnet/Modbus devices, check that those are operative.

IMPORTANT: In case you want to check the complete integration with the cloud, remember that you will need to have an account created as well as the device registered and added to this account. Please, refer to the user manual for the ST Cloud Control solution for more information about that.

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7 Electrical & Mechanical Features

Enclosure	Plastic, type PC (UL 94 V-0) Net dimensions (dxwxh): 93x53x58 mm Recommended space for installation (dxwxh): 100x60x70mm Color: Light Grey. RAL 7035
Mounting	Wall. DIN rail EN60715 TH35.
Terminal Wiring (for power supply and low-voltage signals)	Per terminal: solid wires or stranded wires (twisted or with ferrule) 1 core: 0.5mm^2… 2.5mm^2 2 cores: 0.5mm^2… 1.5mm^2 3 cores: not permitted
Power	1 x Plug-in screw terminal block (3 poles) Positive, Negative, Earth 9-36 VDC / 24 VAC / 50-60 Hz / 0.140 A / 1.7 W
Ethernet	1 x Ethernet 10/100 Mbps RJ45 2 x Ethernet LED: port link and activity
Port	1 x Serial EIA485 (Plug-in screw terminal block 3 poles) A, B, SGND (Reference ground or shield) 1500VDC isolation from other ports
Operation Temperature	0°C to +60°C
Operational Humidity	5 to 95%, no condensation
Protection	IP20 (IEC60529)

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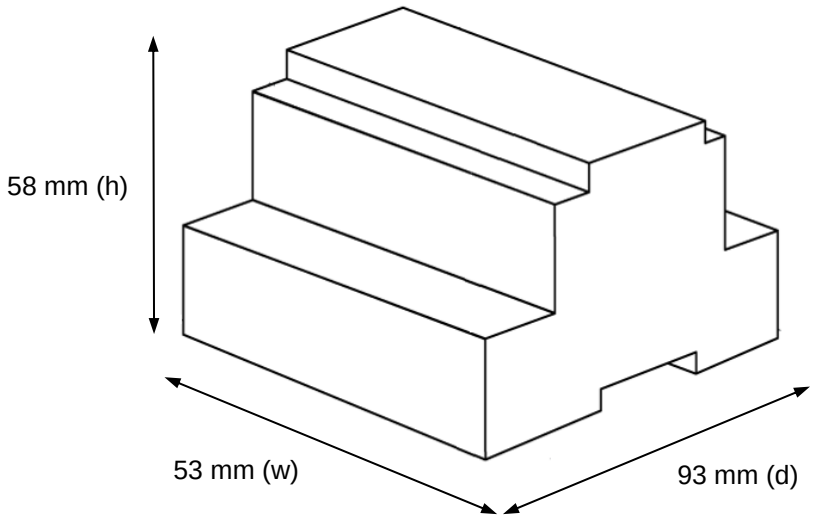
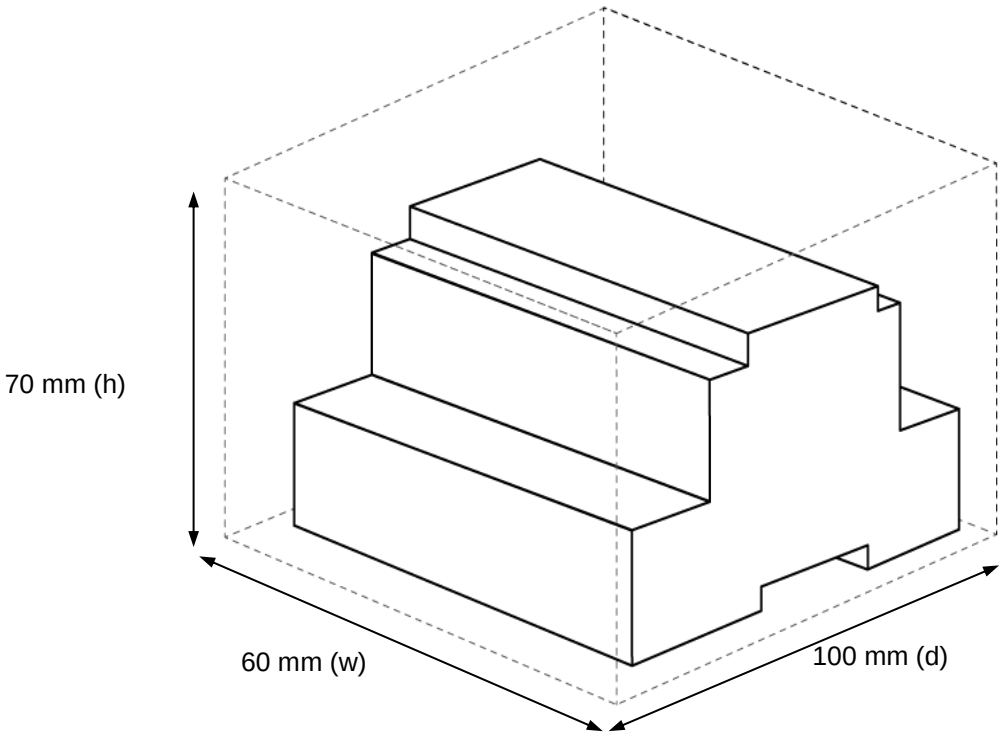
8 Dimensions



Recommended available space for its installation into a cabinet (wall or DIN rail mounting), with space enough for external connections



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